MINOR PROJECT REPORT
(MSCH6040)

On

PHYSICAL AND CHEMICAL ANALYSIS OF RED CHILLI AND TURMERIC

Submitted in Partial Fulfilment of the Requirement the Degree of M.Sc. chemistry

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School of Basic and Applied Science

CERTIFICATE

This is to Certify that Ms. **Pooja Pantola** has carried out his/her minor project work entitled "**Physical and Chemical Analysis of Red Chili and Turmeric**" under my supervision. This work is fit for submission for the award of Master Degree in Chemistry.

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CANDIDATE DECLARATION

I hereby declare that the dissertation entitled "**Physical and Chemical Analysis of Red Chili and Turmeric** " submitted by me in partial fulfillment for the degree of M.Sc. in Chemistry to the Division of Chemistry, School of Basic and Applied Science, Galgotias University, Greater Noida, Uttar Pradesh, India is my original work. It has not been submitted in part or full to this University of any other Universities for the award of diploma or degree.

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PROJECT SUMMARY

Spices and condiments are added to foods in small amounts but they make important contribution to the sensory qualities due to presence of volatile and fixed oils. Apart from all these, consumption of spice provides infinite health benefits.

In this study, the physical and chemical analysis of Red Chili and Turmeric was reported. It is done for detection of food adulterants in chilli powder and turmeric powder. Various samples of the above-mentioned spices were tested to determine the adulteration levels and the qualitative difference between them. The tests were carried out by chemical analysis and visual inspection in above mentioned products.

Visual analysis is performed by using various parameter like colour, mold contamination, damaged matter, broken matter, rodent contamination, sieve size, etc.

Chemical analysis is performed by some specific tests like moisture determination, Total ash determination, Acid insoluble ash, crude fiber, Non – volatile ether extract, colour value, etc.

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1.0 INTRODUCTION

In the culinary arts, the word spice refers to any dried part of a plant, other than the leaves, used for seasoning and flavouring a recipe, but not used as the main ingredient.[1]

Every other part of the plant, including dried bark, roots, berries, seeds twigs, or anything else that isn't the green leafy part, is considered as spice. Today, India produces about 75% of the world's spices They even created the Indian Institute of Spices Research (kerala) devoted to the study of spices.[5]

In world trade of spices India is at number three with 8.8% of the share. The major spices exported by India are Chillies (40%), Turmeric (10%), Cumin (10%), Coriander (9.5%), Fenugreek (4.2%), Peppers (4%) and others (19%). Though these spices provide innumerable benefits they should be used sparingly. The excessive use of spices in food can cause harm to the health. [6]

Spices don't actually spoil or rot, they will lose their flavour over time. As spices are generally added precisely to add flavour, it is best to use them in a certain amount of time. They are defined as "a strongly flavoured or aromatic substance of vegetable origin, obtained from tropical plants, commonly used as a condiment". Spices were once as precious as Gold. India plays a very important role in the spice market of the world. In ancient times majority of the spices were produced in India and exported worldwide.[7] It was then, the spices of India attracted people across the borders and forced them to come to India for Spice trade.

These highly aromatic berries, barks, leaves, stems, buds, roots and seeds have long been prized. They have been used in rituals, customs, anointing royalty and mask the taste of spoiling food. Spices are still as valuable today, with only a small amount needed to heighten and enhance the taste of culinary creations. Spices are grown all over the world. Many are still harvested the way they have been for centuries. Vanilla beans, for example are an expensive spice in part because of their labour-intensive, cultivation and curing.[9] Only Mexican bees and humming birds can pollinate the plants in nature, so workers do it by hand using a bamboo splinter.

The powerful nuances of volatile oils are what give spices their distinct flavours. Thyme, and cinnamon are among the best know aromatic spices. Mincing, grinding and processing release these volatile chemicals. This is why ground spices have such a nice aroma.[10]

The study two specific spices have been done and prepared further for any references i.e. Red Chilli and Turmeric.

1.1 RED CHILI

Names in Hindi – Lal Mirch, Mirchi powder

Binomial Name – *Capsicum annuum*

Indian food or Indian recipes are greatly influenced with this powder. The hot flavour of the chilli powder really enhances the recipes There are hardly dishes which are served without using red chilli powder. You can easily get red chilli powder in the grocery stores. Normally there are two types of red chilli, one which have dark red colour with less spice and the other one having light red colour with great amount of spice. At the time of buying always go for the superior quality of chilli powder.[8] It would be advisable to read the labels of commercial brands and it should be taken care that the chili powder does not include the free-flowing agents and the additional preservatives.

1.1.1 USES OF RED CHILI

1) Chilli powder is the base for making any flavoured, hot and spicy food.
2) Chilli powder is greatly used for various types of veg and non veg marinades.
3) It is highly incorporated in various salads, kachumber's and tomato-based sauces.[3]
4) The ethnic dishes are mostly imparted with the flavour and heat blend of the chilli powder.
5) It is an ultimate ingredient, responsible to add a lovely and wonderful red colour and sharp flavour in any recipe.
6) Colourless and Tasteless dishes can be easily enhanced and improved with the little amount of this hot, spicy and colourful ingredients.

1.1.2 STORAGE OF RED CHILI

1) Red chilli powder can be stored for 10-12 months.
2) It is important to store it at cool and dry place.
3) It should be always kept away from the direct sunlight and heat.
4) Airtight containers or jars are perfect place to store red chilli powder.
5) For keeping it fresh for long time, you can put a chunk of asafoetida in it.

1.1.3 BIOCHEMICAL IMPORTANCE OF RED CHILI

1) Red chillies are highly incorporated with the great rich content like Vitamin C and pro vitamin A.
2) Red chillies consist the huge amount of capsaicin, which helps in boosting metabolism.
3) Capsaicin is proven an effective treatment for sensory nerve fibre disorder.[5]

4) Red chilli is known as a natural pain reliever.
5) It also helps in clearing the congestion of the stuffed-up nose and congested lungs.
6) It is an effective treatment to prevent the stomach ulcers.
7) Red chilies are greatly helping the obsess people, it helps in losing weight and boost the immunity in the body.[11]

1.2 TURMERIC

Name in Hindi - Haldi

Binomial Name – *Curcuma longa*

The yellow color in many Indian, Thai, and Asian dishes and spice blends is often due to the turmeric spice. It is also known as *Indian saffron* since the spice is native to India and imparts the same color as saffron. Both fresh turmeric root and dried, ground turmeric powder is used in cooking. In addition to being used across Asia, it is also found in Middle Eastern cooking. Turmeric roots and powder are available year-round.[4]

Turmeric is a spice that comes from the root of the turmeric plant. This flowering plant is part of the ginger family and is native to Southeast Asia and the Indian subcontinent. The roots of the plant are what is used in cooking. The fresh root is oblong and knotty, similar to ginger root. Dried, ground turmeric is a yellow powder that can vary widely from deep yellow-orange to bright yellow, depending on the variety.[5] Turmeric is a typical ingredient in curries and a component of curry powder. It is suitable for gluten-free, vegan, vegetarian, and paleo diets.

1.2.1 USES OF TURMERIC

1) In India, turmeric is used in almost all curries and gravy dishes. It gives a rich color and a unique flavour to the food.
2) Turmeric is a well-known preservative. Scientists from Gujarat found that adding turmeric to *paneer* (cottage cheese) extends the shelf life of paneer up to 12 days.
3) Turmeric is a great pesticide.[4] Sprinkle turmeric (powder) water near all the entry points of your house to ward of insects, ants, and termites.
4) Turmeric has an important place in Indian weddings. Turmeric paste is applied to the bride and the groom as part of the **haldi** ceremony just before the wedding to give them fresh glowing skins and to ward off the evil eye.
5) Turmeric is considered as a symbol of purity, prosperity, and fertility.
6) Turmeric water is poured / offered to the Gods in the temples as a part of Hindu ritual called **Abhishekam.[3]**

1.2.2 STORAGE OF TURMERIC

1) Ground turmeric should be stored in a sealed container in a cool, dark place.
2) Turmeric will begin to lose its potency after about six months, even sooner if exposed to light and/or heat.
3) Fresh turmeric can be stored in the refrigerator in an airtight container for up to two weeks.

1.2.3 BIOCHEMICAL IMPORTANCE OF TURMERIC

1) Turmeric has been in use since antiquity for its anti-inflammatory (painkiller), carminative, anti-flatulent and anti-microbial properties.
2) The herb contains health benefiting essential oils such as *turmerone, zingiberene, cineole, and p-cymene*.[4]
3) Curcumin, a polyphenolic compound in the root, is the primary pigment that imparts deep orange color to the turmeric. Many laboratory animal studies have suggested that the curcumin may have anti-tumor, antioxidant, anti-arthritic, anti-amyloid, anti-ischemic, and anti-inflammatory properties.
4) This traditional herb does not contain any cholesterol; however, it is rich in antioxidants and dietary fiber, which helps to control blood LDL or "bad cholesterol" levels.[5]
5) It is very rich source of many essential vitamins such as pyridoxine (vitamin B6), choline, niacin, and riboflavin, etc. 100 g herb provides 1.80 mg or 138% of daily recommended levels of pyridoxine.
6) The fresh root contains good levels of vitamin-C. 100 g compose of 23.9 mg of this vitamin. Vitamin-C is a water-soluble vitamin and a powerful natural antioxidant, which helps the body develop immunity against infectious agents, and remove harmful free oxygen radicals.
7) Turmeric contains good amounts of minerals like calcium, iron, potassium, manganese, copper, zinc, and magnesium.

2.0 METHODS AND METHODOLOGIES

2.1 PHYSICAL METHOD

Physical Tests are those which are done using our senses i.e. eyes, nose, skin and tongue. It includes visual inspection, manual handling and sensory evaluation.[5]

Various parameters and methods for physical test -

S.No.	PARAMETERS	METHOD
1.	**Color**	Visual inspection
2.	**Mold contaminations**	Visual inspection
3.	**Living or dead insects**	Visual inspection
4.	**Rodent contamination**	Visual inspection
5.	**Extraneous matter**	Manual handling
6.	**Sieve size**	Manual handling
7.	**Damaged matter**	Manual handling
8.	**Broken**	Manual handling
9.	**Odour/Taste**	Sensory evaluation

2.1.1 *METHODOLOGY*

1) Mix the sample thoroughly.
2) Take out 100-200 gram of sample.
3) Separate the extraneous materials by using physical methods & keep it in a petri dish, weigh and note the weight.

2.1.2 *CALCULATION*

Weight of the sample: A

Separated Extraneous matter: B

Percentage of foreign matter =(B/A) × 100

2.2 CHEMICAL METHOD

2.2.1 *APPARATUS REQUIRED*

Sieve (30 BSS), Mixer Grinder, Weighing balance, Butter paper, Brush, Spoon/spatula.

2.2.2 *METHODOLOGY*

1) 100-150 gram of representative sample is taken.
2) Sample was grinded and passed through 30 BSS sieve (in the both case with red chili and turmeric sieve pore size should be 30 BSS).

3.0 SPECIFIC TESTS FOR CHEMICAL ANALYSIS

In chemical analysis there both similar and different specific tests for Red chili and turmeric.

FOR RED CHILI POWDER

1) Moisture determination
2) Total Ash determination
3) Acid insoluble ash
4) NVEE (Non-volatile Ether Extract)
5) Crude fiber
6) SHU (Scoville Heat Unit)
7) CV (Color Value)

FOR TURMERIC POWDER

1) Moisture determination
2) Total Ash determination
3) Acid insoluble ash
4) Curcumin
5) Starch
6) Lead Chromate

3.1 MOISTURE ANALYSIS

Distillation techniques involve co-distilling the water in a food sample with a high boiling point solvent that is immiscible in water, collecting the mixture that distils off, and then measuring the volume of water.[3]

The distillation method is AOAC - approved technique for moisture analysis of spices, cheese and animal feeds. It can also give good accuracy for nuts, oils, soaps and waxes.

3.1.1 *APPARATUS*

Weighing balance, Butter paper, Brush, Spoon/spatula, Dean and Stark distillation apparatus, Copper wire for washing, Heating mantle.

3.1.2 *REAGENTS*

Toluene AR grade, CaCl anhydrous.

3.1.3 *METHODOLOGY*

1) Weigh 5 g sample in distillation flask and cover completely with solvent.
2) Fill the receiving tube (Dean and Stark moisture trap) with solvent by pouring through the top of the condenser
3) Insert a loose cotton plug at the top of the condenser containing anhydrous CaCl.
4) Bring to a boil and slowly distil at the rate of 2 drops/sec until most of the water is collected, then increase the rate to approximately 4 drops/sec
5) After the distillation has proceeded for approximately 1 hour, wash with a wire dislodge moisture from the condenser and top part of moisture trap.
6) Continue till two consecutive readings.
7) Rinse the brush and wire with toluene before removing the condenser.
8) Allow the apparatus to cool to ambient temperature before measuring the volume of water in the trap.

Fig. 1 Dean and stark distillation apparatus

3.1.4 CALCULATION

Moisture % = Volume of water(ml) / Weight of sample (g) × 100

Volume of water(ml) = 0.05 x Reading

a. Calculation For red chili powder-
Sample wt. = 10.2374
Volume of water = 0.38 ml
Moisture % = 0.38 × 100/10.2374
Moisture = 3.7 % …….. (1)

b. Calculation For turmeric powder-
Sample wt. = 10.0603 g
Volume of water = 0.7 ml
Moisture % = 0.7 × 100/10.0603
Moisture = 6.15 %.....(2)

3.1.5 PRECAUTIONS

1) To control emulsion breakages, allow the apparatus to cool when distillation is completed.
2) Use clean glassware (used chromic acid for cleaning).
3) To avoid moisture interference from outside, put cotton plug containing CaCl2 at the top of the condense.

3.2 TOTAL ASH ANALYSIS

Ash is incombustible residue of any substance i.e. the remains completely burnt material, the dust or powdery substance which a material is reduced after complete combustion. In the process water and volatiles area evaporized and organic substances are burned in the presence of oxygen in the air to CO_2 and oxides. Most minerals are converted to oxides, sulphates phosphates, chlorides and silicates.[6]

3.2.1 *APPARATUS*

Weighing balance, Brush, Spoon/spatula, Crucible, Muffle furnace regulated at 550±25 °C.

3.2.2 *REAGENT*

Absolute alcohol.

3.2.3 *METHODOLOGY*

1) Weigh accurately 2g of well mixed sample in the tarred crucible
2) Pour about 2 ml of ethanol on the material in the tarred dish and char it.
3) Ignite in the muffle furnace for 2 hours at 550±25 °C.
4) If ignition is incomplete wet the sample with 1-2 drops of water and put it again in muffle furnace for 1 hour.
5) Continue till two consecutive readings.

1.1.4 CALCULATION

Total ash (dry basis) % = (W1-W2) × 100 × 100/ Wt. of sample (100-M)

W1= weight of crucible with ash content.

W2= weight of empty crucible.

M= moisture content of sample.

a. Calculation For red chili powder –

Wt. of sample = 2.0146 g
W2 = 21.8386 g
W1= 21.9164 g
M = 3.71 %.....(from result 1)
Total Ash = {(21.9164 - 21.8386) × 100 × 100} / {2.0146 (100 – 3.71)}
Total Ash = 4.01 %

b. Calculation For turmeric powder –

Wt. of sample = 2.0300 g
W2 = 21.3833 g
W1 = 21.5063 g
M= 6.15 %.....(from result 2)
Total Ash = {(21.5063 – 21.383) × 100 ×100} / {2.0300 (100-6.15)}
Total Ash = 6.47 %

1.1.5 PRECAUTIONS

1) Use clean and tarred crucible.
2) Take care of filter paper during filtration to avoid its tearing.
3) Wash the filter paper properly.

3.3 ACID INSOLUBLE ASH

Acid-insoluble ash describes a procedure for determining the acid-insoluble ash content of cellulose samples. The sample is dry- ashed and the residue treated with hydrochloric acid. The insoluble residue is filtered, washed, ignited, and weighed. This method measures all acid insoluble material.[5]

3.3.1 *APPARATUS*

Weighing balance, Brush, Spoon/spatula, Filter paper (Whatman No. 42), Beaker 25

3.3.2 *REAGENT*

Hydrochloric acid diluted in water 1:2.5 (v/v).

3.3.3 *METHODOLOGY*

1) Add to the test portion 25 ml of HCL and boil for 10 minutes
2) Allow to cool and filter the content through ash less filter paper.
3) Wash the filter paper thoroughly with hot water until the washings are free from HCl as tested by pH strip.
4) Put the filter paper in the same crucible.
5) Ignite the muffle furnace for 1 hour at 550 ± 25 °C.
6) Cool the dish in the desiccator and weight.
7) Continue till two consecutive readings.

Fig. 2 Testing procedure for acid insoluble ash

3.3.4 *CALCULATION*

Acid insoluble ash (dry basis) % = [(W1-W2) 100 × 100] / Wt. of the sample (g) (100-M)

W1-weight of crucible with ash content.

W2-weight of empty crucible.

M-Moisture content of sample.

a) Calculation For red chili powder -

W1 = 21.3902 g
W2= 21.3833 g
Wt. of sample = 2.0249 g
M = 3.71 %
Acid insoluble ash (dry basis) % = {(21.3902 – 21.3833) × 100 × 100} / 2.0249 × (100 - 3.71)
Acid insoluble ash (dry basis) % = 0.35%

b) Calculation For turmeric powder -

W1 = 21.1638 g
W2 =21.1694 g
Wt. of sample = 2.0084 g
M = 6.15%
Acid insoluble ash (dry basis) % = [(21.1694 – 21.1638) × 100 × 100] / 2.0084 (100-6.15)
Acid insoluble ash (dry basis) % = 0.29 %

3.3.5 PRECAUTIONS

1) Use clean and tarred crucible
2) Filter paper used should be ash less.
3) Take care of filter paper during filtration to avoid its tearing.
4) Wash the filter paper properly.

3.4 LEAD CHROMATE

Turmeric fingers seen in television commercials are actually coloured. Commercially available pure turmeric powder should be consumed with extreme discretion. Modern day turmeric (I mean starch powder like tapioca) is adulterated with Lead Chromate, Methyl yellow and other yellow dyes which are highly carcinogenic.[5]

3.4.1 *APPARATUS*

Test tubes, Measuring cylinder, dropper.

3.4.2 *REAGENTS*

Dilute Sulphuric acid - 1:7(v/v), Diphenyl Carbazide solution -0.2% (w/v) in 95 % ethyl alcohol.

3.4.3 *METHODOLOGY*

Ash about 2 gm of the ground sample. Dissolve the ash in 4-5 ml of dilute sulphuric acid in a test tube and add 1 ml of diphenyl carbazide solution. The development of a violet colour indicates the presence of Chromate.

3.4.4 *CALCULATION*

a) Calculation For turmeric powder-

Wt. of sample = 2.0208 g

W1(weight of empty crucible) =20.4329 g

W2(weight of crucible with ash) =20.5835 g

3.4.5 *RESULT*

Orange colour appeared, there is absence of chromate.

3.4.6 *PRECAUTIONS*

1) Use clean and tarred crucible.
2) Take care of filter paper during filtration to avoid its tearing.
3) Wash the filter paper properly.
4) Filter paper used should be ash less.

3.5 NON- VOLATILE ETHER EXTRACT

Extraction of the material with diethyl ether, removal of the volatile fractions, removal of the insoluble substances, drying of the non-volatile residue and weighing.[6]

3.5.1 *APPARATUS*

Flat bottom flask 250 ml, Soxhlet extraction unit, Water bath, Whatman thimble tube, Tissue paper, Cotton, Balance.

3.5.2 *REAGENT*

Diethyl Ether.

3.5.3 *METHODOLOGY*

1) Weigh exactly 2.5 g of sample on tissue/ filter paper.
2) Extract the sample in continuous extraction apparatus (Soxhlet Extraction) with diethyl ether for 18 hrs. Keep the temperature at 60-70°C.
3) After complete extraction, remaining ether is transferred in the round bottom flask and ether is removed by evaporating water bath.
4) Then flask is transferred in hot air oven at 110 ± 2°C for 1 hr to complete removal of diethyl ether.
5) Cool the flask in the desiccator and take the weight till the loss in weight between successive weighing is less than 2 mg.
6) Take the lowest reading.
7) Calculate % NVEE with the help of following formula given below.

Fig. 3 Soxhlet extractor

3.5.4 *CALCULATION*

% NVEE (on dry basis) = [(W1-W2) × 100 × 100] ⁄Wt. of the sample in gm × (100-M)

W1-weight of flask in g containing non-volatile extract.

W2-weight of empty flask.

a) Calculation For red chili powder –

W2 = 102.6810 g

W1= 103.0196 g

Wt. of the sample= 2.4062 g

M = 3.71%

NVEE (on dry basis) = {(103.0196 – 102.6810) × 100 X 100 / 2.4062 × (100-3.71)

% NVEE (on dry basis) = 14.6%

3.5.5 *PRECAUTIONS*

1) Sample should be passed through 60 BSS mesh.
2) Sample weight should not be less than 2.5 g.

3.6 STARCH ANALYSIS

In particular, starch is often present in a semi-crystalline form (granular or retrograded starch) that is inaccessible to the chemical reagents used to determine its concentration. It is therefore necessary to isolate starch from the other components present in the food matrix prior to carrying out a starch analysis.[5]

3.6.1 *APPARATUS*

R.B flask 500 ml, with TS. 1926 ground joint, West type condenser 400 nm in length, Volumetric flask 500 m with ground glass stopper, Gooch crucible, Pipettes transfer type 5, 10, 20 and 50 ml, Burette 50 ml graduated in 0.1 ml.

3.6.2 *REAGENTS*

1) Hydrochloric acid solution,
2) sodium hydroxide solution, ca. 2 5N, (10% w/v)
3) Ethyl ether, ACS grade, anhydrous

4) Ethyl alcohol solution, 10% by volume
5) Ethyl alcohol
6) Asbestos- Special acid washed for Gooch crucibles. Make asbestos pulp by shaking with distilled water
7) Modified Fehling's solution:
    a. Copper sulphate solution-Dissolve 34.639 g of copper sulphate (CuSO4 .5H20) in distilled water, dilute to 500 ml and filter through prepared asbestos.
    b. Alkaline tartrate solution-Dissolve 173g of sodium potassium tartrate (Rochelle salt) and 50g of NaOH in distilled water. Dilute to 500 mL, allow to stand for 2 days and filter through prepared asbestos.
8) Indicator paper (universal).

3.6.3 METHODOLOGY

1) Weigh 4 g of sample and transfer to a funnel containing a Whatman No 2. or equivalent filter paper. Extract the sample with 5 successive 10 ml portions of ethyl ether. Allow the ether to evaporate from the residue, wash with 150 mL of the 10% alcohol solution, and then with 15 to 20 ml. of absolute ethyl alcohol.
2) Carefully transfer the insoluble residue from the filter paper to the 500 ml R.B flask with water, using a wash bottle and gently rubbing the paper with rubber policeman. Add distilled water to make the total volume 200 mL and then add 20 ml of the HCL solution. Connect the Mask to reflux condenser and boil for 2.5 hours.
3) Cool and add 25N NaOH solution slowly with stirring until the solution is almost neutral to indicator paper (pH 6-7). Solution must not be alkaline any time. Transfer to the 500 ml volumetric flask, make to volume at room temperature and mix well.
4) To determine the amount of reducing sugars, filter the hydrolysation through a dry filter paper, discarding the first 10 ml portion of filtrate. Add 25 ml each of the copper sulphate and alkaline tartrate solution into a 400 mL beaker and add an aliquot of the filtered sample solution. If the aliquot is less than 50 mL, add distilled water to make the final volume 100 ml.
5) Cover the beaker with a watch glass and heat on an asbestos gauze over Bunsen burner or on a hot plate. The burner or hot plate must be pre-set to bring the solution to boil in 4 minutes. Continue boiling for 2 minutes.
6) Filter the hot solution immediately through the prepared, tared Gooch crucible with the aid of suction Wash the precipitated Cu O thoroughly with water at ca. 60°C. Then wash the precipitate with 10 ml of ether. Dry the precipitate for 30 minutes in an oven at $110^{o} \pm 2^{o}C$ cool to room temperature in a desiccator and weigh accurately.

3.5.3 CALCULATION

Dextrose, % = Wt. of dextrose (mg) x 500X0.1/Wt. of sample(g) × aliquot (ml.)

Starch %= % dextrose x 0.90

W1= wt. in gram of G4 before ash analysis.

W2= wt. in gram of G4 after ash analysis.

W= weight of sample in gram.

a) Calculation for Turmeric powder –

W1= 39.2056 W2= 39.6429

W= 4.0034

A: 39.2056 – 39.6429 = 0.4373

DEXTROSE % = [208.15 × 500 × 0.1] / 4.0034 × 50

DEXTROSE % = 51.99 %

STARCH% = 51.99 × 0.9 = 46.79%

3.6.5 *PRECAUTIONS*

1) Take care of filter paper during filtration to avoid its tearing.
2) Wash the filter paper proper.
3) Use clean glassware (used chromic acid for cleaning).

3.7 CRUDE FIBER

Crude Fiber is a measure of the quantity of indigestible cellulose, pentosans, lignin, and other components of this type in present foods. It is the residue of plant materials remaining after solvent extraction followed by digestion with dilute acid and alkali.[5]

3.7.1 *APPARATUS*

Round bottom flask-1000 m, Balance, pH strips, Heating mantle, Condenser, Nylon cloth, G4 crucible, Measuring cylinder-250ml, Beaker.

3.7.2 *REAGENT*

Sulphuric acid-1.25%, NaOH-1.25%, Distilled water, Absolute Alcohol

3.7.3 *METHODOLOGY*

1) Transfer the defatted sample from the thimble to preheated round bottom flask.
2) Pour 200 ml of 1.25% pre boiled H2S04 into the flask &place it on the heating mantle for boiling.
3) The boiling is continuing for an hrs exactly.
4) Then filter with the help of nylon cloth and thoroughly wash the residue without distilled water till acid free completely.
5) Again transfer the residue into preheated round bottom flask and pour 200 ml1.25% NaOH.
6) Boil it exactly for an iron heating mantle.
7) Filter with the help of nylon cloth.
8) Wash with hot distilled water thoroughly till alkali free, checked by pH strip.
9) Transfer the residue in the G4 crucible with the help of water.
10) Remove the water with help of vacuum filtration.
11) Finally wash the residue with 25 ml absolute alcohol.
12) After removing the alcohol, transfer the G4 in the hot air oven for 1 hour at 110 ±2°C.
13) Cool in desiccator and take the weight. It is initial weight (W1)
14) Finally transfer the G4 in the muffle furnace for 30 minutes regulated at550+20°C.
15) Cool in desiccator and take the final weight(W2).
16) Calculate the % Crude Fiber with the help of following formula.

3.7.3 CALCULATION

(% crude fiber on dry basis) = [(W1-W2) × 100 × 100] / W (100 - M)

W1 = Wt. in g of G4 before ash analysis

W2= Wt. in g of G4 after ash analysis

W = Wt. of sample in gram

M = Moisture content

a) Calculation for red chili powder –

W1= 39.2056 g

W2= 39.6429 g

W= 2.5002 g

M= 3.71

% of Crude fiber on dry basis = [(34.6429 –34.2056) × 100 × 100 / 2.5002(100-3.71)

% of Crude fiber on dry basis = 18.16 %

3.7.4 PRECAUTIONS

1) Sample should be passed through 60 BSS mesh.
2) Digestion time in acid or alkali should be exactly for 30 minutes.
3) Boiling should be started within 1 minute.

3.8 SHU (Scoville Heat Unit)

Scoville scale is a measurement of the pungency (spiciness or "heat") of chili peppers and other spicy foods, as recorded in Scoville Heat Units (SHU) based on the concentration of capsaicinoids, among which capsaicin is the predominant component.[5]

3.8.1 *APPARATUS*

Sample, 95% ethanol, 250 ml flat bottom flask, Condenser suit, Whatman serial no 1 filter paper, Heat mantel, 1 ml pipette, 100 ml volumetric flask.

3.8.2 *METHODOLOGY*

1) Take 1gram sample (powdered form).
2) Add 100 ml 95% Ethanol, (all in flat bottom flask).
3) Add condenser suit and keep it on heat mantel for three hours on 10-degree Celsius.
4) Let it cool down at room temperature, then filter it in volumetric flask with filter paper.
5) Let the flask fill up to its maximum volume i.e. 100 ml.
6) Use the pipette (1 ml) to draw out the quantity of the sample as told.
7) Pour it in a washed volumetric flask, then make up the flask with 3% sucrose.
8) Serve it to judges for tasting.

3.8.3 *CALCULATION*

Y = 10000 / X

SHU = Y/sample weight

where, X is the solution drawn by the pipette.

a) Calculation For red chili powder –

Sample wt. = 1.0044 g

X= 0.27 ml

Y =10000/ .27 = 37037.03

SHU = 37037.03/1.0044

SHU = 36874.79

3.8.4 *PRECAUTIONS*

1) Sample weight should not be less than 1 g.
2) Set the apparatus on heat mantel with utmost care.

3.9 COLOUR VALUE

Spices are any pungent, aromatic plant substances used to flavor food or beverages. This study aimed to detect the presence of non-permitted food colours in spices.[6]

3.9.1 *APPARATUS*

Volumetric flask (100 ml), Acetone, Aluminium foil, Whatman filter paper serial no. 1, Cuvette, Spectrophotometer.

3.9.2 *REAGENTS*

Glass reference standard-NIST SRM 2030 or 930, glass filter with A specified by NIST in range 0.4-0.6 at 465 nm.

3.9.3 *METHODOLOGY*

1) Take 0.1 g sample in volumetric flask.
2) Fill acetone at half level i.e. around 50-60 ml.
3) Cover it with foil and keep it in dark for 18 hours.
4) Then filter it in new volumetric flask with Whatman no. 1 paper.
5) Then make it up with pure acetone.
6) Take 2 cubit and fill with acetone and sample respectfully.
7) Do dry it with napkin and place it in the spectrometer
8) Acetone filled in cubit along with the sample is used as blank, represents as a zero point i.e. we place the sample in the photometer on second or third place.
    - Blank
    - Standard
    - Sample

3.9.4 *CALCULATION*

(16.4 × Reading) / sample weight.

a) Calculation For red chili powder –

Sample wt.= 0.1363 g

Reading on spectrometer = 0.525

Colour value = (16.4 × 0.525)/0.1363

Colour value = 63.17

This value is acceptable according to **FSSAI** (Food Safety and Standard Authority).

3.10 CURCUMIN

Curcumin is an ingredient contained in foods made with turmeric or ginger. Curcumin is the principal bioactive constituent of Turmeric; a spice commonly used to flavour and preserve food; it is one of the main ingredients in curry powder.[5]

3.10.1 *APPARATUS*

1) Extraction Flask Flat bottom, 100 ml with TS 24 / 40 ground glass joint
2) Condenser-water cooled, drip tip 300-400 mm length TS24 /40 ground glass joint.
3) Volumetric Flasks- 100 and 250 ml.
4) Spectrophotometer - any suitable type capable of measuring absorbance at 425 nm.

3.10.2 *REAGENTS*

Acetone and Standard Curcumin solution weigh 25 mg of standard curcumin into a 100 ml volumetric flask. Dissolve and dilute to mark with Acetone. Transfer 1 ml of the solution to a 100 ml volumetric flask and dilute to mark with acetone. This standard solution contains 2.5 mg (0.0025gm)/litre.

3.10.3 *METHODOLOGY*

1) Grind sample as quickly as possible in a grinding mill to pass sieve with 1 mm diameter.
2) Weigh accurately about 0.1 gm, add 30 ml alcohol and reflux for two and half hours.
3) Cool the extract and filter quantitatively into a 100 ml volumetric flask.

4) Transfer the extracted residue to the filter.
5) Wash thoroughly and dilute to mark with acetone.
6) Pipette 20 ml of the filtered extract into a 250 ml volumetric flask and dilute to volume with alcohol.
7) Measure the absorbance of the extract and the standard solution at 425 nm in 1 cm cell against an alcohol blank.

3.10.4 *CALCULATION*

% of Curcumin = 25×0.25× sample absorbance / 2 × sample weight × standard absorbance.

a) Calculation For turmeric powder –

Weight of the sample= 1.0005

Absorbance of the sample= 0.214

Curcumin % = 0.214 ×25×0.25/1.0005×2×0.200

Curcumin% = 3.34 %

4.0 CONCLUSION

Quality analysis of spices are extremely important as turmeric and other spices are commonly sold by weight, the potential exists for powders of toxic, cheaper agents with a similar color to be added, such as lead (IV) Oxide, giving turmeric an orange-red color instead of its native gold-yellow. Another common adulterant in turmeric, metanil yellow (also known as acid yellow 36), is considered an illegal dye for lease in foods by the British Food Standards Agency.

Also, high levels of moisture in ground or whole spices indicate mould and microbial growth. During storage, insects breed on spices in varying degrees, depending upon storage conditions, where they are harvested, transportation contamination and the extent of cleaning. Filth levels include foreign materials such as insect fragments (moths, mites, beetles), small stones, metal fragments and glass pieces. Insects and mould growth can change the colour. Microbiological requirements for clean' spices include counts for total bacteria, yeast, mould, coliforms and food pathogens such as Escherichia coli and Salmonella.[4]

Many spices rely on color control as a symbol of product quality. The ASTA (American Spice Trade Association) has even compiled a list of standardizations for spice analysis using color control methods. For example, the color control of the highly popular spice, paprika, uses ASTA "Color Units" as an international standard for measuring extractable color and is determined by spectrophotometric method. The "Color Unit" score is then used to indicate product quality and set the price. [10]

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